

First record of the scorpion genus *Microtityus* from Colombia, with the description of a new species (Scorpiones, Buthidae)

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Abstract. *Microtityus* (*Microtityus*) *franckei* sp. nov. is described from both male and female specimens from the transition zone of the Tayrona Natural National Park, located in the Caribbean region of Colombia. The new species, which is the first of the genus reported from Colombia, is characterized, among other features, by reductive neobothriotaxy on the pedipalp femur and chela. The new species raises to 25 the number of known species of *Microtityus*, ten of which are present in continental South America. A revised diagnosis of the genus, a species check-list, and some biogeographic and taxonomic considerations are included.

Keywords: Scorpions, taxonomy, Tayrona Natural National Park

The genus *Microtityus* Kjellesvig-Waering 1966 is a group of scorpions including 24 known species (one fossil) and two subspecies (Armas 1999; Fet & Lowe 2000; Teruel 2000, 2001; González-Sponga 2001; Teruel & Armas 2006; Teruel & Infante 2007). The genus is known mainly from the Caribbean islands, with seven species present in Cuba, five in the Dominican Republic, one in Trinidad and Tobago, and one in the U.S. Virgin Islands—St. Thomas and St. John Islands (Francke & Sissom 1980; Armas 1999; Fet & Lowe 2000; Teruel 2000, 2001; Teruel & Armas 2006; Teruel & Infante 2007). Even though Armas (1974:24) mentioned the presence of this genus in Puerto Rico (according to a personal communication from M.A. González-Sponga), no species from that island is known to date. Similarly, although Santiago-Blay et al. (1990) made reference to the genus in Haiti, they did not mention the specific identity of populations from that country, and no paper stating the presence of any species of *Microtityus* in Haiti has yet been published. In continental South America this genus is represented by a lower number of species; eight from Venezuela and only one from Brazil (Fet & Lowe 2000; González-Sponga 2001).

Armas (1974) created the subgenus *Microtityus* (*Parvabsonus*) for the Cuban species *Microtityus fundorai* Armas 1974, *Microtityus jaumei* Armas 1974 and *Microtityus trinitensis* Armas 1974, and 13 species from Caribbean islands have been described in the subgenus. More recently, Teruel (2000) defined two species-groups within *Microtityus* (*Parvabsonus*) to separate the species with reductive neobothriotaxy (*M. jaumei* group: femoral trichobothrium d_2 absent) from those with orthobothriotaxy (*Microtityus waeringi* Francke & Sissom 1980 group: femur with the complete set of trichobothria). Even though the remaining species are placed within the nominal subgenus, their subgeneric position should be reevaluated—as has already been indicated by Fet & Lowe (2000). A check-list of the species and the countries where they are known to occur as well as the current subgeneric and species-group placements are presented in Table 1. *Microtityus starri* Lourenço & Huber 1999 and *Microtityus iviei* Armas 1999 are not included in the table since Prendini (2001) synonymized the former species with *Microtityus rickyi*

Kjellesvig-Waering 1966, and Teruel (2005) considered the second an invalid taxon.

The relatively high species richness of this genus in Venezuela contrasts strongly with neighboring countries such as Brazil with a single species, and Colombia and Guyana where *Microtityus* is unrecorded. Despite this situation, recent collections carried out by the second author at the transition zone of the Tayrona Natural National Park (Fig. 1) discovered a new population of *Microtityus* that corresponds to a new species that is herein described and assigned to the nominal subgenus. The new species is the first of the genus to be known from Colombia, raising to five the number of buthid genera in the country: *Ananteris* Thorell 1891, *Centruroides* Marx 1890, *Microtityus*, *Rhopalurus* Thorell 1876 and *Tityus* Koch 1836.

METHODS

Photographs were taken using an Olympus D-590 ZOOM digital camera. Illustrations were prepared with the aid of a *camera lucida* mounted onto a Zeiss Stemi SV 6 stereoscope. Measurements (L = length, W = width, D = depth) are presented in millimeters and were obtained following the methodology of Sissom et al. (1990) using the program Motie Images 2000 version 1.2 through a PC connected to a Motie Digital Microscope DM-143. The distribution map was produced with the program ArcView GIS version 3.1 (Environmental Systems Research Institute (ESRI), Redlands, California). All specimens are preserved in 70% ethanol.

General carinal terminology follows Vachon (1952), except for the mesosomal carinae that are here distinguished as follows. In the tergites: axial, dorsolateral and lateral carinae; in the sternites: paramedian and lateral carinae. According to Vachon's (1952) terminology for the carinae on the pedipalp femur, the carina that follows the dorsointernal is referred to as ventrointernal (see Vachon 1952:fig. 65); however, in the specimens studied herein there is an additional and more ventral carina to which the term ventrointernal is more suitable, thus making it necessary to replace Vachon's (1952) term ventrointernal for internal median. Trichobothrial terminology follows Vachon (1973, 1975). In the present paper, the notion of subgenus is used as an optional rather than obligatory category.

Table 1.—Checklist of the species of *Microtityus* and the countries where they have been reported. Species marked with single asterisk (*) belong to the *M. waeringi* species-group while those with double asterisk (**) belong to the *M. jaumei* group according to Teruel's (2000) proposal.

Species	Brazil	Colombia	Cuba	Dominican Republic	Trinidad and Tobago	Venezuela	U. S. Virgin Islands
<i>M. (Microtityus) aubarensis</i> (Schawaller 1982) (fossil)				X			
<i>M. (Microtityus) augelaerosae</i> González-Sponga 2001						X	
<i>M. (Microtityus) biordi</i> González-Sponga 1970						X	
<i>M. (Microtityus) capayaeusis</i> González-Sponga 2001						X	
<i>M. (Microtityus) desuzei</i> González-Sponga 2001						X	
<i>M. (Microtityus) franckei</i>		X					
<i>M. (Microtityus) joseantonioi</i> González-Sponga 1981						X	
<i>M. (Microtityus) litoralensis</i> González-Sponga 2001						X	
<i>M. (Microtityus) rickyi</i> Kjellesvig-Waering 1966					X		
<i>M. (Microtityus) sevciki</i> González-Sponga 2001						X	
<i>M. (Microtityus) vauzolinii</i> Lourenço & Eickstedt 1983	X						
<i>M. (Microtityus) yaracuyanus</i> González-Sponga 2001						X	
<i>M. (Parvabsonus) consuelo</i> Armas & Marciano-Fondeur 1987 *				X			
<i>M. (Parvabsonus) difficilis</i> Teruel & Armas 2006 **			X				
<i>M. (Parvabsonus) dominicanensis</i> Santiago-Blay 1985 *				X			
<i>M. (Parvabsonus) farleyi</i> Teruel 2000 *			X				
<i>M. (Parvabsonus) fuudorai</i> Armas 1974 **			X				
<i>M. (Parvabsonus) guantanamo</i> Armas 1984 *			X				
<i>M. (Parvabsonus) jaumei</i> Armas 1974 **			X				
<i>M. (Parvabsonus) kovariki</i> Teruel & Infante 2007 **			X				
<i>M. (Parvabsonus) lantiguai</i> Armas & Marciano-Fondeur 1992 *				X			
<i>M. (Parvabsonus) paucidentatus</i> Armas & Marciano-Fondeur 1992 **				X			
<i>M. (Parvabsonus) trinitensis</i> Armas 1974 **			X				
<i>M. (Parvabsonus) virginiae</i> Armas 1999 *				X			
<i>M. (Parvabsonus) waeringi</i> Francke & Sissom 1980 *							X

Acronyms of museums: Museo Javeriano de Historia Natural "Lorenzo Uribe S. J.," Pontificia Universidad Javeriana, Bogotá, Colombia (MPUJ); Instituto de Ciencias Naturales, Museo de Historia Natural, Universidad Nacional de Colombia, Bogotá, Colombia (ICN-MHN).

TAXONOMY

Family Buthidae Koch 1837

Genus *Microtityus* Kjellesvig-Waering 1966

Microtityus Kjellesvig-Waering 1966:130.

Type species.—*Microtityus rickyi* Kjellesvig-Waering 1966 by original description.

Revised diagnosis.—Very small scorpions (less than 25 mm length); general coloration yellowish to reddish-yellow with variegated pigmentation; carapace sub-triangular and emarginated, with three pairs of lateral eyes; pedipalps either orthobothriotaxic [11 trichobothria on femur in A- α configuration, 13 on patella and 15 on chela; subgenus *Microtityus* (*Parvabsonus*) (in part, only *M. waeringi* group), subgenus *Microtityus* (*Microtityus*) (in part)], with only femur neobothriotaxic [trichobothrium d_2 absent: *Microtityus* (*Parvabsonus*) (in part, only *M. jaumei* group), *Microtityus* (*Microtityus*) (in part)], with both femur and chela neobothriotaxic [*Microtityus* (*Microtityus*) (in part)], or with only chela neobothriotaxic [*Microtityus* (*Microtityus*) (in part, only

Microtityus litoralensis González-Sponga 2001)]; dentate margin of pedipalp movable fingers composed of 9–12 oblique rows of granules, without accessory granules; tergites with three or five longitudinal carinae; pectines with well developed fulcra; sternum sub-pentagonal; booklung spiracles ovoid; subaculear tubercle strong and rhomboidal.

Microtityus (Microtityus) franckei sp. nov.

Figs. 1–14; Tables 1–3

Type material.—*Holotype*: COLOMBIA: *Department of Magdalena*: adult female, Santa Marta, transition zone of the Tayrona Natural National Park, Kalache Kalabria private reserve, 11°16'21"N, 74°04'59.9"W, December 2006, J.A. Noriega (MPUJ-SCO-366).

Paratypes: COLOMBIA: *Department of Magdalena*: 2 adult males, collected with holotype (MPUJ-SCO-367, ICN-MHN-As-650).

Etymology.—The species name is a patronym dedicated to Oscar F. Francke, arachnologist at the Universidad Nacional Autónoma de México, in recognition of his many contributions to scorpology and acknowledgment of his advice in the senior author's research.

Diagnosis.—The new species seems to be most closely related to both *Microtityus joseantonioi* González-Sponga 1981 and *Microtityus desuzei* González-Sponga 2001 from Venezuela, with which it shares the presence of only 10

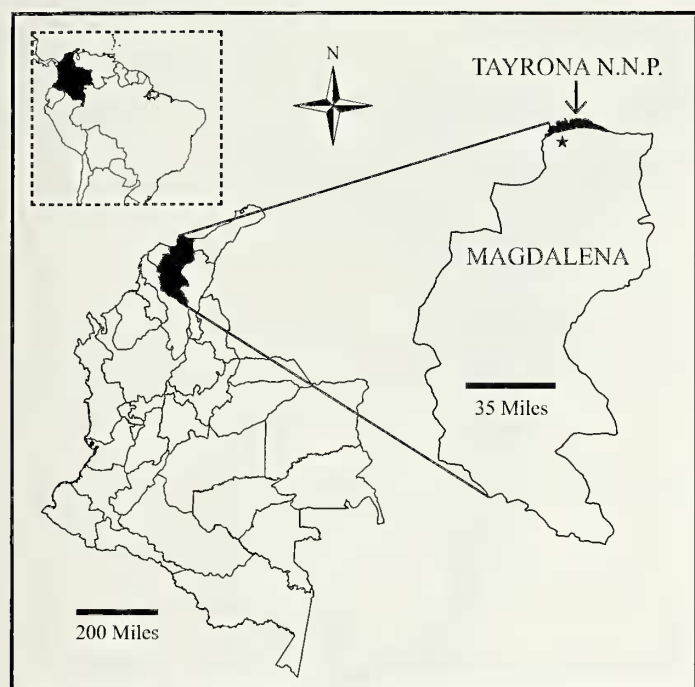


Figure 1.—Location of the type locality of *Microtityus franckei* sp. nov.

trichobothria on the pedipalp femur (d_2 absent) and 12 on the chela (Eb_3 , Esb and esb absent) (Figs. 9, 10, 13, 14; Table 2), rather than the standard pattern of 11 and 15 trichobothria on both segments, respectively. *Microtityus franckei* can be readily distinguished from both species of the neighboring country because it bears 11–12 rows of granules in the movable finger of pedipalps, the internal tubercle on the base of pedipalp femur is low and non-spinoid in both sexes (Figs. 9, 10), and sternite V of males exhibits only one hyaline and smooth area, which is shaped like an equilateral triangle (Fig. 8). In contrast, judging from the original descriptions, in *M. joseantonioi* and *M. desuzei* the movable finger presents 9 rows of granules, the internal tubercle on the base of the pedipalp femur is pronounced and spinoid (González-Sponga 1981:fig. 11; González-Sponga 2001:fig. 7), and sternite V of males exhibits 3 hyaline and smooth areas (González-Sponga 1981, 2001) of which the median one is higher than wide in *M. joseantonioi* (González-Sponga 1981:fig. 14). The new species may be also distinguished from *M. desuzei* in that it presents five carinae in tergites I–VII, rather than only three as in the second species (González-Sponga 2001).

Description of the female holotype (MPUJ-SCO-366).—Measurements in Table 3. **Coloration:** carapace predominantly yellow with abundant dark-brown mottling. Median ocular tubercle dark-brown. Chelicerae yellow with some brownish areas located basally on both fixed and movable fingers, and one externally on tibia; teeth reddish. Tergites almost completely yellow; I–IV with brown regions restricted to the posterior margin and separated from each other by the longitudinal carinae; V–VII with few, disperse brown spots. Coxosternal region with all the components yellowish, with abundant brown spots that are darker in coxapophyses II and are fused in a great brown area obscuring coxapophyses I almost completely. Genital operculum yellow with a small

brown area located laterally on each piece. Basal piece of the basal lamellae of the pectines with few spots; the remaining pieces and the pectinal basal piece completely yellow. Sternites with few dark-brown spots. Metasoma yellowish with brown mottling throughout. Telson predominantly yellow, brownish basally near the dorsal surface; body of the subaculear tubercle and distal area of the vesicle brown, margins of the subaculear tubercle yellow; aculeus dark-red over almost its entire length, yellow basally. Pedipalps with variegated pigmentation over dorsal, internal, and external surfaces of all segments, ventral surfaces completely yellow; fixed and movable fingers brown-colored basally and yellow over the rest of their lengths. Legs with variegated pigmentation in all segments.

Carapace: subtriangular, densely granulose throughout; anterior margin moderately emarginated; median ocular tubercle slightly anterior to the center of the carapace; lateral ocular tubercles each with three ocelli; median ocular and posterior median carinae granulose and moderately strong; other carinae and furrows inconspicuous.

Chelicerae: with abundant setae on internal and ventral surfaces; cheliceral dentition characteristic of the family Buthidae (Vachon 1963). Movable finger externally with two small basal teeth, one median pronounced, one subdistal slightly shorter than the median, and one distal tooth. Internally with two small teeth, one basal and one median, and one distal tooth that is longer than its external counterpart. Fixed finger externally with one basal and one median tooth mounted onto a bicuspid, one subdistal, and one distal tooth. Internally with only one small tooth located slightly basal in respect to the external subdistal.

Coxosternal region: sternum pentagonal with a deep median depression; all the components of this region granulose; coxapophyses I–II anteriorly with dense pilosity.

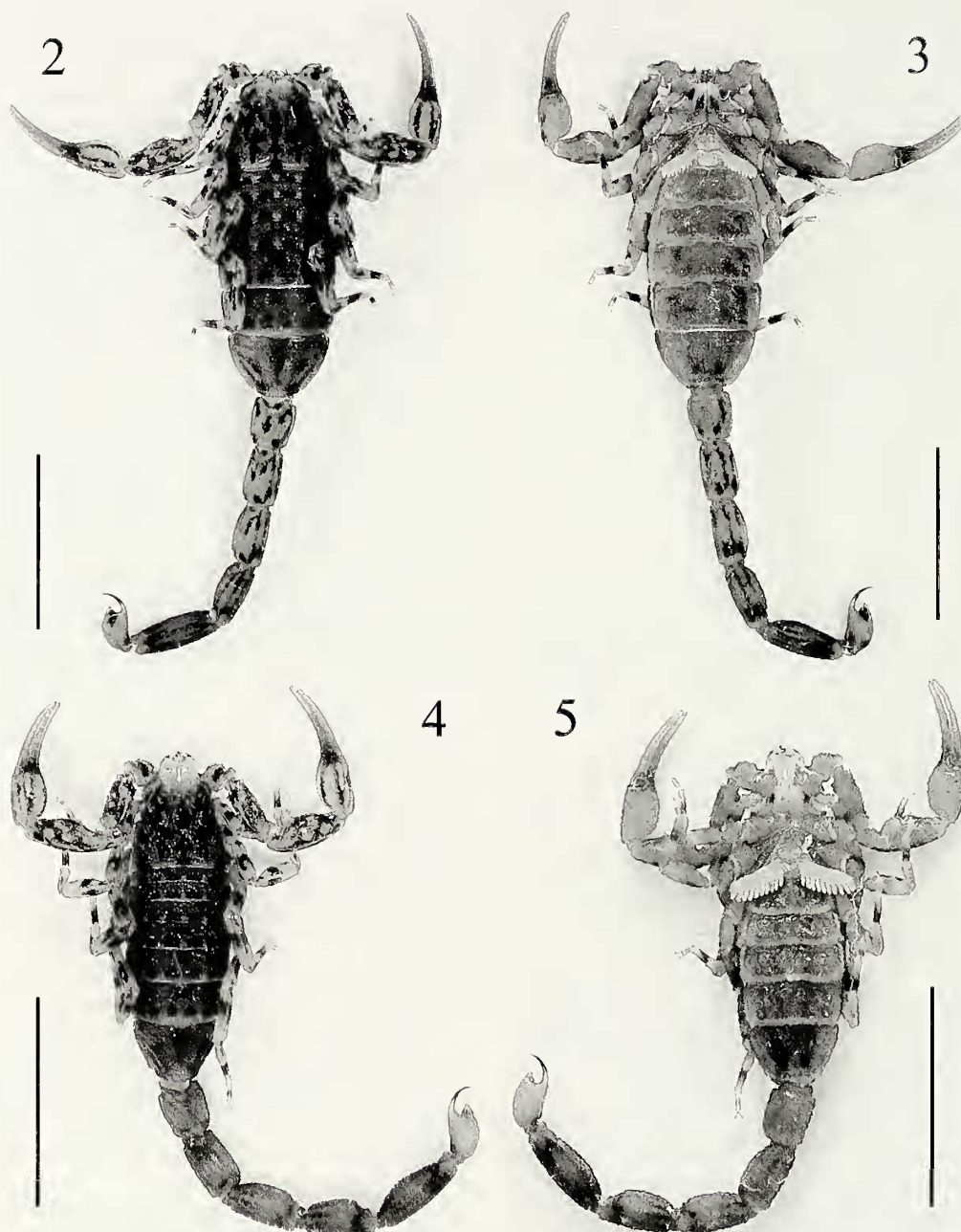
Tergites: with similar granulation to that of the carapace; five longitudinal carinae (axial, paired dorsolateral and lateral carinae) are present on the posterior half of tergites I–VI and are formed by elevated granules that are arranged linearly, the posterior most granule on each carina is markedly stronger and surpasses the margin of the tergite; tergite VII pentacariniate.

Genital operculum and pectines: genital operculum divided longitudinally; pieces count on the pectines: basal lamellae 3:3, middle lamellae 6:6, fulcrum 7:8, teeth 8:9; pectinal basal piece almost quadrangular in shape, expanded distally and with the posterior margin straight (Fig. 6).

Sternites: densely granulose throughout; sternites VI–VII with paired paramedian and lateral carinae, incomplete and granulose; booklung spiracles short and oval.

Metasoma: segments I–II with ten carinae (paired ventral, ventrolateral, intermedian, dorsolateral and dorsal carinae); segments III–IV with eight (intermedian carinae absent); segment V with five (axial, paired ventrolateral and dorsolateral carinae); all carinae serrulose; intercarinal spaces granulose. Telson with axial carina that terminates in a rhomboidal subaculear tubercle that is curved towards the aculeus and exhibits two small dorsal granules; aculeus strongly curved.

Pedipalps: densely granulose throughout; femur with five longitudinal carinae (dorsoexternal, dorsointernal, ventrointernal, ventroexternal and internal median carinae), and low



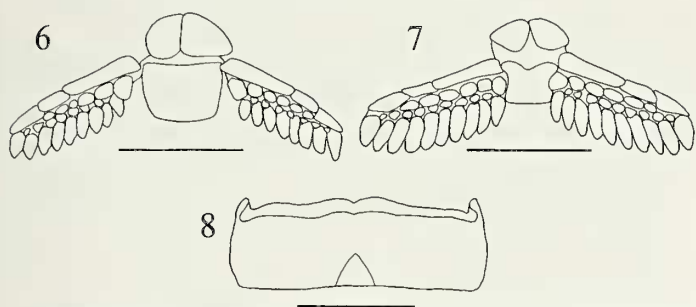
Figures 2-5.—*Microtityus franckei* sp. nov., dorsal and ventral views. 2-3. Female holotype (MPUJ-SCO-366); 4-5. Male paratype (MPUJ-SCO-367). Scale bars equal 5 mm.

and non-spinoid tubercle located basally on the internal surface (Figs. 9, 10); patella with seven longitudinal carinae [all of those identified by Vachon (1952:figs. 66-68) except for the ventral median that is absent], with two spinoid granules on the dorsointernal carina and one in the ventrointernal (Fig. 11); hand with seven longitudinal carinae [all of those identified by Vachon (1952:fig. 69)], of which the dorsal axial, dorsal accessory and intermedian carinae extend over part of the fixed finger; all carinae granulose. Movable fingers with 12 slightly imbricate rows of granules in both pedipalps; fixed fingers with ten rows. Pedipalps neobothriotaxic; trichobothriotaxy Type A, femur with α configuration (Figs. 9-14) (Vachon 1973, 1975); femoral trichobothrium d_2 absent

(Fig. 9); patellar d_2 petite and almost indistinguishable (Fig. 11); Eb_3 , Esb and esb absent on chela (Fig. 13).

Legs: tibia, basitarsus and telotarsus with abundant setation; prolateral and retrolateral pedal spurs present on all legs.

Comparisons with male paratypes.—MPUJ-SCO-367: Measurements in Table 3. The following features differ from those described for the female holotype: tergites V-VI with similar coloration pattern to the preceding tergites. Coxapophyses II and coxae I-IV completely yellow. Pieces count on the pectines: fulcra 9:9, teeth 10:10. Pectinal basal piece less expanded than the female's and emarginated anteriorly (Fig. 7). Sternite V with a posterior median hyaline and smooth area, which is



Figures 6–8.—*Microtityus franckei* sp. nov. 6–7. Genital operculum, pectines and pectinal basal piece. 6. Female holotype (MPUJ-SCO-366); 7. Male paratype (MPUJ-SCO-367). 8. Sternite V of male paratype (MPUJ-SCO-367). Scale bars equal 1 mm.

shaped like an equilateral triangle (Fig. 8). Cheliceral dentition identical to that of the female. Pedipalp movable fingers with the same 12 rows of granules of the female.

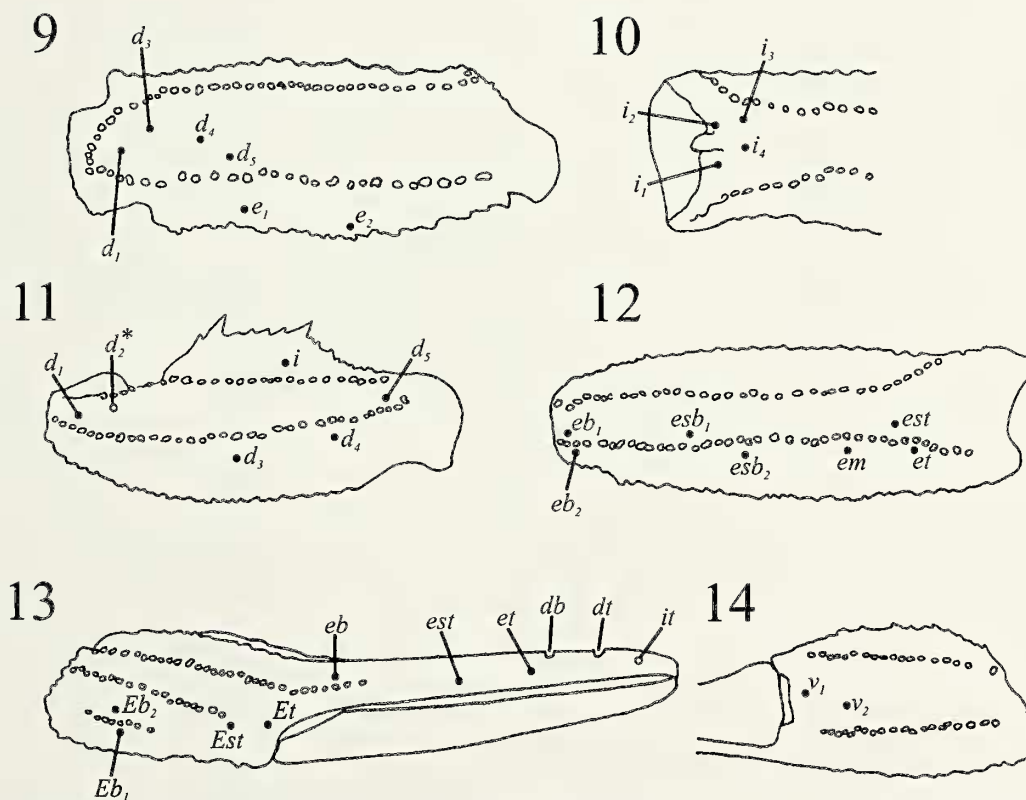
ICN-MHN-As-650: Measurements in Table 3. Similar to the other male, except that patellar trichobothrium d_2 is absent in both pedipalps, pedipalp patella bears eight longitudinal carinae with ventral median carina present, and the movable fingers present 11:12 rows of granules.

Distribution.—*Microtityus franckei* is known only from the type locality: Kalache Kalabria private reserve at 11°16'21"N, 74°04'59.9"W (Fig. 1). This species inhabits the Santa Marta Montane Forests ecoregion, which rises from very different habitat of xeric scrub and dry forest that surround it. This ecoregion is a mountain massif whose northern edge runs just

off the coast of the Caribbean Sea. Due to both plant and animal endemism it is considered a Pleistocene refuge, although its diversity is relatively low and limited in comparison with other Neotropical ecoregions (National Geographic Society 2001).

Field observations and sympatric species.—All of the specimens were hand captured in daylight from under stones in the dry bed of a river at 134 m above sea level. This species was found in sympatry with *Ananteris columbiana* Lourenço 1991, *Tityus tayrona* Lourenço 1991, and an unidentified species of *Chactas* Gervais 1844.

Some biogeographic and taxonomic considerations.—Even though Armas & Mareano-Fondeur (1992) suggested that reductive neobothriotaxy has occurred independently more than once within *Microtityus*, Teruel (2000) rejected such an hypothesis arguing that: (i) the loss of trichobothria is an infrequent phenomenon in the family Buthidae and when it occurs in various species of the same genus, it is a synapomorphic condition; (ii) the *M. jaumei* species-group is a natural lineage that seems to have evolved from an orthobothriotaxic ancestor—an hypothesis supported by the presence of this condition in the most ancient species of the genus known to date, *Microtityus ambarensis* (Schawaller 1982) from Dominican amber of 40–30 mya. Although Teruel's (2000) consideration—which was not backed by a cladistic analysis—seems correct for the Caribbean species of *Microtityus* [subgenus *Microtityus* (*Parvabsonus*)], it appears inappropriate when the continental species are considered since this region is occupied also by both orthobothriotaxic



Figures 9–14.—Distribution of the trichobothria in female holotype *Microtityus franckei* sp. nov. (MPUJ-SCO-366). 9. Femur, dorsoexternal view; 10. Femur, internal view; 11. Patella, dorsointernal view; trichobothrium with * is petite; 12. Patella, external view; 13. Chela, external view; 14. Chela, ventral view.

Table 2.—Trichobothriotaxy of the species currently assigned to *Microtityus* (*Microtityus*). Ortho = Orthobothriotaxic; Neo = Neobothriotaxic. Trichobothria in parentheses are absent.

Species	Femur	Patella	Chela	References
<i>M. ambarensis</i>	Ortho	Ortho	Ortho	Santiago-Blay et al. 1990; Teruel 2000
<i>M. angelaerosae</i>	Neo (d_2)	Ortho	Neo (<i>esb</i>)	González-Sponga 2001
<i>M. biordi</i>	Ortho	Ortho	Ortho	González-Sponga 1970
<i>M. capayaensis</i>	Neo (d_2)	Ortho	Ortho	González-Sponga 2001
<i>M. desuzei</i>	Neo (d_2)	Ortho	Neo (Eb_3 , <i>Esb</i> , <i>esb</i>)	González-Sponga 2001
<i>M. franckei</i>	Neo (d_2)	Ortho/Neo (d_2)	Neo (Eb_3 , <i>Esb</i> , <i>esb</i>)	This paper
<i>M. joseantonioi</i>	Neo (d_2)	Ortho	Neo (Eb_3 , <i>Esb</i> , <i>esb</i>)	González-Sponga 1981
<i>M. litoralensis</i>	Ortho	Ortho	Neo (Eb_3 , <i>Et</i> , <i>esb</i>)	González-Sponga 2001
<i>M. rickyi</i>	Ortho/Neo (d_2)	Ortho	Ortho	Kjellesvig-Waering 1966; Vachon 1977; Armas 1988; Prendini 2001
<i>M. sevciki</i>	Neo (d_2)	Ortho	Ortho	González-Sponga 2001
<i>M. vanzolinii</i>	Ortho	Ortho	Ortho	Lourenço & Eickstedt 1983
<i>M. yaracuyanus</i>	Neo (d_2)	Ortho	Ortho	González-Sponga 2001

and neobothriotaxic species (Table 2). In contrast to the neobothriotaxy observed in some insular *Microtityus*, which consists of the absence of only femoral trichobothrium d_2 , South American representatives exhibit various different types of neobothriotaxy (Table 2). The distributions of both orthobothriotaxic and neobothriotaxic species indicate that

the second condition may have appeared independently more than once. We suggest that an orthobothriotaxic ancestor—probably belonging to the nominal subgenus as it is supported by the fossil evidence—passed from South America to the Caribbean lands about 37–35 mya when both plates were in contact (Iturralde-Vinent & MacPhee 1999). Such an ancestor

Table 3.—Morphometric measurements (mm) of female holotype and male paratypes of *Microtityus franckei* sp. nov.

		Female holotype (MPUJ-SCO-366)	Male paratype (MPUJ-SCO-367)	Male paratype (ICN-MHN-As-650)
Total body length (including telson)		18.65	16.33	14.79
Carapace	Length	2.28	1.86	1.95
	Anterior W	1.38	1.07	1.14
	Posterior W	2.72	2.10	2.29
	Ocular diameter	0.13	0.09	0.10
	Interocular distance	0.20	0.18	0.23
Mesosoma	Total L	5.84	4.71	3.20
Metasoma	Total L (including telson)	10.51	9.76	9.64
	Segment I L	1.32	1.18	1.12
	Segment I W	1.25	1.04	1.09
	Segment I D	1.24	0.97	1.01
	Segment II L	1.59	1.46	1.47
	Segment II W	1.04	0.92	0.93
	Segment II D	1.03	0.91	0.90
	Segment III L	1.64	1.54	1.54
	Segment III W	0.98	0.87	0.86
	Segment III D	0.95	0.91	0.87
	Segment IV L	1.66	1.54	1.62
	Segment IV W	0.90	0.81	0.86
	Segment IV D	0.87	0.86	0.86
	Segment V L	2.43	2.37	2.20
	Segment V W	0.78	0.79	0.80
	Segment V D	0.85	0.87	0.86
	Telson L	1.89	1.67	1.69
	Vesicle W	0.74	0.70	0.65
	Vesicle D	0.77	0.68	0.69
Pedipalps	Total L	7.72	7.72	6.41
	Femur L	1.83	1.48	1.58
	Femur W	0.63	0.55	0.58
	Patella L	2.17	1.75	1.82
	Patella W	0.91	0.69	0.74
	Chela L	3.72	3.05	3.01
	Chela W	0.89	0.79	0.79
	Chela D	0.86	0.74	0.73
	Movable finger L	2.46	1.88	1.92

may then have originated the first form of *Microtityus* (*Parvabsonus*) from which both the *M. jaumei* and the *M. waeringi* groups evolved and diversified. In South America, actual neobothriotaxic species may have evolved, too, from orthobothriotaxic ancestors. These hypotheses await rigorous testing with cladistic analyses, as is the monophyly of *Microtityus* (*Parvabsonus*). Considering that only *M. joseantonioi*, *M. desuzei*, and *M. franckei* share the same trichobothrial pattern it is plausible that these species may be closely related phylogenetically.

Taking into account that Venezuela exhibits a high species richness for this genus in comparison to Colombia, the discovery of *M. franckei* suggests that more species of *Microtityus* may be present in Colombia. This also takes into account one described species exists in the state of Amazonas, Brazil – namely *Microtityus vanzolinii* Lourenço & Eickstedt 1983, plus an additional species from the state of Matto Grosso, partly illustrated by González-Sponga (2001: fig. 23), which yet remains undescribed.

ACKNOWLEDGMENTS

The authors wish to express special gratitude to Erich S. Volschenk, Mark S. Harvey (Western Australian Museum, Perth), Oscar F. Francke (Universidad Nacional Autónoma de México), Paula E. Cushing (Denver Museum of Nature and Science, Denver), and Lorenzo Prendini (American Museum of Natural History, New York) for reading earlier drafts of the manuscript and making valuable comments that led to its improvement; and to Rolando Teruel (Centro Oriental de Ecosistemas y Biodiversidad, Santiago de Cuba), Luis F. de Armas (La Habana, Cuba) and O.F. Francke for their kind help in acquiring relevant literature and fruitful discussions previous to and throughout the construction of the manuscript. Additional thanks are due to Juan Carlos Dib (Universidad del Magdalena, Santa Marta, Colombia) for his hospitality during the second author's stay at Kalache Kalabria private reserve, to Juan Manuel Renjifo and Camila Renjifo for their help in the field, to Giovanny Fagua (PUJ, Bogotá) for the loan of some laboratory equipment, to Luis G. Pérez (PUJ) for his help in obtaining the measurements, and to Andres R. Acosta (PUJ) for providing helpful information about ecoregions. Thanks to R. Pinto da Rocha and the organizing committee of the 17th International Congress of Arachnology for financial support that allowed the first author to attend the ISA Congress.

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Manuscript received 19 October 2007, revised 12 March 2008.